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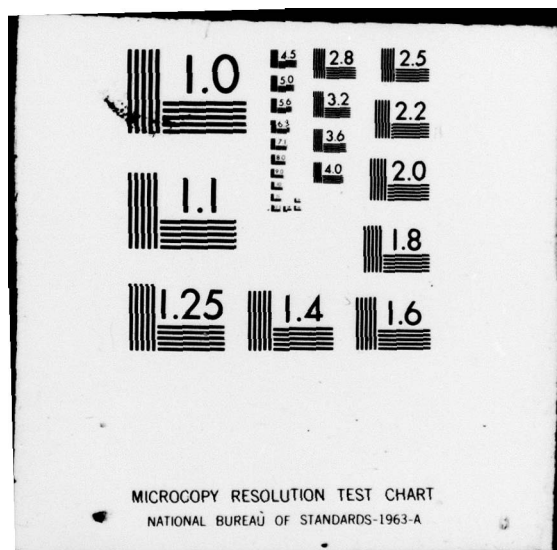
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Technical Report 420

**SOUNDS RECORDED IN THE PRESENCE  
OF AN ADULT AND CALF BOWHEAD  
WHALE, BALAENA MYSTICETUS.**

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10 D. K. Ljungblad and S. Leatherwood  
(NOSC)

M. E. Dahlheim

National Marine Fisheries Service  
Seattle, WA 98115

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Final Report: May 1978

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SAN DIEGO, CALIFORNIA 92152

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frequency ranged from 50 Hz to 580 Hz. In three instances, a Type A sound was followed immediately by a Type B sound. Fifteen Type B sounds ranged from 0.65 to 2.56 seconds in duration, with the fundamental frequency ranging from 100 Hz to 195 Hz.

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# ABSTRACT

Low-frequency sounds were recorded on 23 May 1978 in the presence of an adult bowhead whale and accompanying calf, near Point Barrow, Alaska. The ice conditions at that time were changing. The ice pack was moving toward the shore-fast ice, with the imminent possibility of total lead closure. Under these conditions, sounds were detected 10 minutes before whales were sighted in the lead at an estimated distance of 400 to 500 m from our position. Of the 75 vocalizations recorded, 35 were of sufficient quality to be analyzed. These sounds were of two types, identified throughout this text as Type A, short duration sounds, and Type B, long duration sounds. Eighteen were Type A and ranged from 0.35 to 0.85 seconds in duration; the fundamental frequency ranged from 50 Hz to 580 Hz. In three instances, a Type A sound was followed immediately by a Type B sound. Fifteen Type B sounds ranged from 0.65 to 2.56 seconds in duration, with the fundamental frequency ranging from 100 Hz to 195 Hz.

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## INTRODUCTION

To date, there has been little information available on sounds produced by bowhead whales, *Balaena mysticetus*. Aldrich (1889)<sup>1</sup> described their sounds (heard through the hull of his boat and therefore somewhat modified) as resembling "the hoo-oo-oo of a hoot owl though longer and drawn out and more of a humming sound than a hoot." He also referred to a slight rise in the pitch and the number of calls, noting that: "Beginning on F, the tone may rise to G, A and B, and sometimes to C before sliding back to F again." Alaskan Eskimos have also referred to the voice of the bowhead, describing grunts, roars, and, borrowing from their more recent familiarity with animals of other regions, elephant-like trumpeting. (Conrad Oozeva, 1978, personal communication to S. Leatherwood.)

Over the years many attempts have been made to record the bowhead whale. Unfortunately, most of the available recordings, when analyzed, proved to be those of the bearded seal (*Erignathus barbatus*). \* (Scott McVay's recordings of 1971 and 1973)<sup>2</sup> include some sounds that are similar to those described here.

On 23 May 1978, near Point Barrow, Alaska, vocalizations of an adult bowhead whale and/or an accompanying calf were recorded. This paper describes the circumstances surrounding the recording of these sounds and summarizes basic characteristics of the sounds.

## MATERIALS, METHODS AND RESULTS

The National Marine Fisheries Service, Seattle, Washington, maintained spring ice-camp census stations along the near-shore-lead off Pt. Barrow, Alaska, to count migrating whales (Krogman).<sup>3</sup> They conducted this census during the annual spring migration of the Western Arctic bowhead whales, which were migrating from their wintering grounds in the Bering Sea to their summering grounds in the eastern Beaufort Sea and Amundsen Gulf (Braham et al. 1978).<sup>4</sup>

From 21 through 24 May 1978, we recorded at North Camp, approximately 71.28°N, 156.34°W. On the morning of the 23rd, the nearshore lead, which had been open to widths of up to 6.6 km for the preceding six weeks closed from just northeast of the camps to a distance of at least 10 km north and eastward.

Sounds in the lead were monitored by a U. S. Navy Sonobuoy (AN/SSQ-41/A), modified to increase its frequency response to 40 kHz. The hydrophone was at a depth of 7 m. The signal was monitored by a 100-kHz bandwidth vhf receiver, Defense Electronics Instrumentation. The tape recorder (NAGRA SJ) had a 40-kHz bandwidth.

Although no whales were seen all morning, about 1250 sounds began to be audible increasing in relative intensity for the next 10 minutes. At 1300, two bowhead whales were sighted, one estimated to be 13 to 15 m and one 4.5 to 6 m long. The whales surfaced in the open water east of the camp at an estimated distance of about 500 m. They approached the ice edge, then circled the area for 50 minutes, at one point approaching to within 300 m of the hydrophone. The relative size and closely coordinated movements of the two whales led us to conclude they were a female and her calf.

<sup>1</sup>Superscript numbers identify references at end of report.

\*William A. Watkins, 1978, personal communication to D. K. Ljungblad.



Sounds recorded were subjectively classified by type, with a description of each. A Spectral Dynamics Model 301A real-time analyzer provided a continuous cathode ray tube and paper display of frequency and relative level as a function of time. Frequency content and signal duration were determined from these displays.

During the one-hour recording (1250-1350) 75 vocalizations were recorded from the whales. Of these, 33 were of sufficient intensity relative to background noise to be well analyzed and were of two basic types:

Type A sounds (figure 1A and table 1) were 0.35 to 0.85 seconds in duration (average 0.59 seconds), characterized by higher frequency, particularly near their termination. These sounds occurred 18 times and ranged in frequency from 50 to 580 Hz, with the average lower frequency limit of 210 Hz and higher frequency limit of 324 Hz. Typically, the analysis showed no well-defined harmonics.

In comparison, Type B (figure 1B and table 2) sounds were usually longer in duration (0.65 to 2.56 seconds) (average 1.65 seconds), characterized by a relatively constant frequency. These sounds occurred 15 times and their fundamentals ranged in frequency from 100 to 195 Hz, with an average lower frequency limit of 140 Hz and a higher frequency limit of 164 Hz. These sounds often had energy up to the seventh harmonic.

Table 1. A list of Type A sounds produced by an adult and calf bowhead whale.  
Sounds are arranged in increasing order of signal duration.

	Duration of fundamental, sec	Lowest frequency, Hz	Highest frequency, Hz	Fundamental	Harmonics						
					2	3	4	5	6	7	
	0.30	60	220	X							
	0.35	220	240	X							
	0.4	150	170	X							
	0.45	150	320	X							
	0.45	120	380	X							
	0.5	120	395	X							
	0.5	160	300	X							
	0.55	145	390	X							
	0.55	150	410	X							
	0.6	50	100	X							
	0.6	140	350	X							
	0.65	120	180	X							
	0.7	155	195	X	X						
	0.7	125	580	X							
	0.75	130	360	X							
	0.8	135	540	X							
	0.8	150	580	X							
	0.85	165	350	X							
Range	0.35-0.85	50-220 Hz			100-580 Hz						
Mean	0.59 seconds	210 Hz			324 Hz						

Table 2. A list of Type B sounds (indicated generally by their harmonic structure, Watkins, 1967)<sup>5</sup> produced by an adult and calf bowhead whale. Sounds are arranged in increasing order of signal duration.

Duration of fundamental, sec	Lowest frequency, Hz	Highest frequency, Hz	Fundamental	Harmonics						
				2	3	4	5	6	7	
0.65	140	150	X							
1.2	120	160	X	X	X					
1.35	160	190	X	X	X	X	X	X		
1.45	100	120	X	X						
1.5	150	160	X	X	X					
1.55	140	150	X		X	X				
1.65	100	130	X							
1.65	120	150	X	X	X	X	X	X		
1.7	180	195	X	X	X					
1.75	150	180	X	X						
1.75	120	170	X	X	X	X	X	X		
1.85	125	150	X	X	X	X	X	X	X	
2.0	140	180	X	X	X	X				
2.1	180	190	X	X	X	X	X			
2.56	175	180	X	X						
Range 0.65-2.56 Seconds		100-400 Hz	120-535 Hz							
Mean 1.65 Seconds		140 Hz	165 Hz							

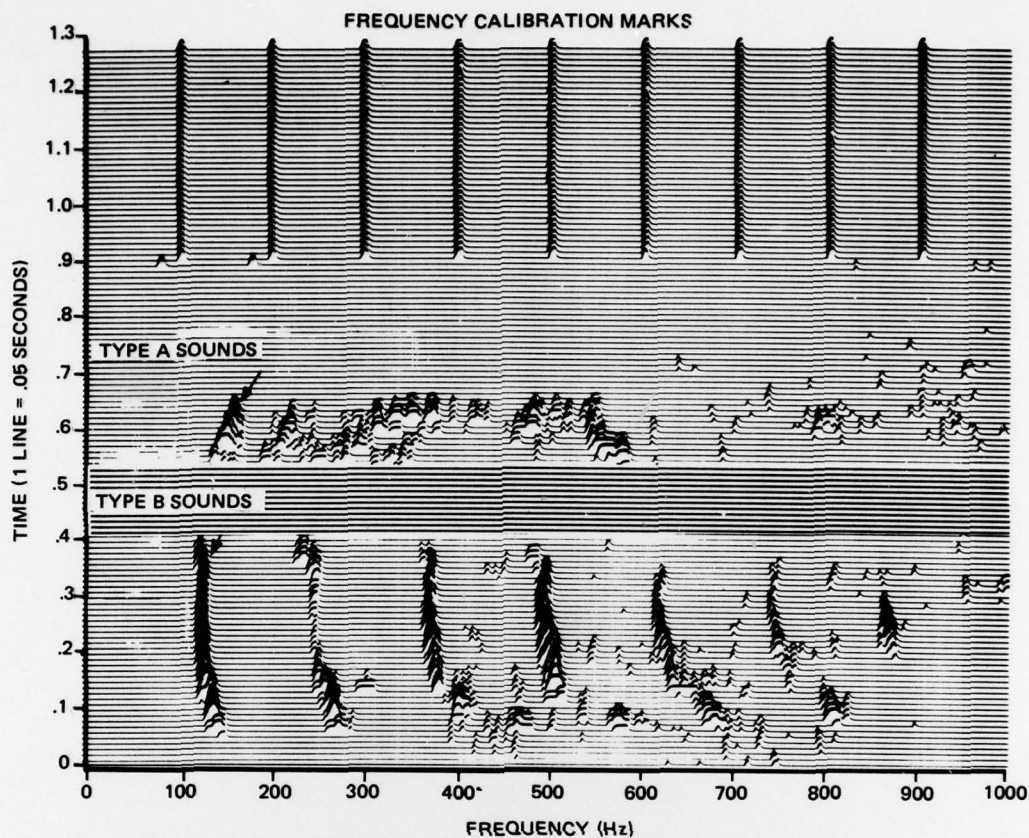


Figure 1. Sample spectrograph.

### DISCUSSION

Observations of the bowhead whales during the period these sounds were recorded indicate an increase in relative intensity level as the whales approached and a decrease as they moved away. The distinctive sounds of bearded seals, *Erignathus barbatus*, (Ray, Watkins and Burns, 1969),<sup>6</sup> and ringed seals, *Phoca hispida*, (Stirling, 1973)<sup>7</sup> recorded earlier in the week, were conspicuously absent on this day. Of the sounds analyzed, the Type A sounds generally were shorter in duration and more variable in frequency than the Type B sounds. The Type B sounds were considerably longer in duration and remained relatively constant in frequency.

There are some apparent similarities between the sound production of bowhead whales and those of the right whales (Cummings et al, 1972).<sup>8</sup> To study the similarities further, more data should be obtained for an objective comparison of sounds.



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